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27366 7590 07/29/2008

WESTMAN CHAMPLIN (MICROSOFT CORPORATION)
SUITE 1400
900 SECOND AVENUE SOUTH
MINNEAPOLIS, MN 55402-3244

EXAMINER	
GODBOLD, DOUGLAS	
ART UNIT	PAPER NUMBER
2626	

DATE MAILED: 07/29/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/724,008	11/26/2003	Zicheng Liu	M61.12-0585	7548

TITLE OF INVENTION: METHOD AND APPARATUS FOR MULTI-SENSORY SPEECH ENHANCEMENT

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	10/29/2008

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

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If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

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B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27366 7590 07/29/2008

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900 SECOND AVENUE SOUTH
MINNEAPOLIS, MN 55402-3244

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Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/724,008	11/26/2003	Zicheng Liu	M61.12-0585	7548

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nonprovisional	NO	$1440	$300	$0	$1740	10/29/2008

EXAMINER	ART UNIT	CLASS-SUBCLASS
GODBOLD, DOUGLAS	2626	704-226000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

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❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

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Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 780 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 780 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Notice of Allowability	Application No.	Applicant(s)	
	10/724,008	LIU ET AL.	
	Examiner	Art Unit	
	DOUGLAS C. GODBOLD	2626	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *communication filed April 24, 2008*.

2. ☒ The allowed claim(s) is/are *1, 2, 5, 6, 9, 11-15, 17, 18, 23, 24, and 29*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 20080515, 20080523
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

1. This Office Action is in response to correspondence filed April 24, 2008 in reference to application 10/724,008. Claims 1, 2, 5, 6, 9, 11-15, 17, 18, 23, 24, and 29 are pending in the application and have been examined.

Response to Amendment

2. The amendments filed April 24, 2008 have been accepted and considered in this application. Claim 12 has been amended.

Response to Arguments

3. Applicant's arguments, see Remarks, filed April 24, 2008, with respect to claims 1, 12, and 14 have been fully considered and are persuasive. The rejections of claims 1, 2, 5, 6, 9, 11-15, 17, 18, 23, 24, and 29 have been withdrawn.

Allowable Subject Matter

4. Claims 1, 2, 5, 6, 9, 11-15, 17, 18, 23, 24, and 29 are allowed.

5. The following is an examiner's statement of reasons for allowance:

6. Consider claim 1, the APA teaches a method of determining an estimate for a noise-reduced value representing a portion of a noise-reduced speech signal (Recently, a system has been developed that attempts to remove noise by using a combination of

an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 line 25.), the method comprising:

generating an alternative sensor signal using an alternative sensor other than an air conduction microphone (This system is trained using three training channels: a noisy alternative sensor training signal… Specification page 2, line 28-30.);converting the alternative sensor signal into at least one alternative sensor vector (Each of the digitized signal frames are converted into a feature domain; Specification page 3, line 2.)

But the APA and Frey does not teach adding a plurality of signal vectors together and wherein each correction vector corresponds to a mixture component and each weight to a correction vector is based on the probability of the correction vector's mixture component, given the alternative sensor vector;

generating an air conduction microphone signal;

converting the air conduction microphone signal into an air conduction vector;

estimating a noise value;

subtracting the noise value from the air conduction vector to form an air conduction estimate;

combining the air conduction estimate and the estimate for the noise-reduced value to form the refined estimate for the noise-reduced value in the power spectrum domain.

In the same field of noise reduction, Zangi teaches adding a plurality of signal vectors together (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090);

generating an air conduction microphone signal (using microphone 26a);

converting the air conduction microphone signal into an air conduction vector (digital frames input to R[I] into signal processor 52);

estimating a noise value (The AP 72 includes the one or more AP filters 74a-74M; adaptive filters imply that an estimate a noise value is calculated. Zangi's adaptive filters operate by estimating a noise spectrum from a noisy signal spectrum and subtracting it from the noisy signal spectrum to produce a "clean" signal. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.);

subtracting the noise value from the air conduction vector to form an air conduction estimate (The AP 72 includes the one or more AP filters 74a-74M; paragraph 0090. Adaptive filters subtract a noise estimate from the noisy signal in order to estimate the signal);

combining the air conduction estimate and the estimate for the noise-reduced value to form the refined estimate for the noise-reduced value in the power spectrum domain (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate. The first processor filters are adapted in accordance with a noise power spectrum at the microphones and the second processor filter is adapted in accordance with a power spectrum of the intermediate output signal; paragraph 0019. Zangi's adaptive filters operates by estimating a noise spectrum from a noisy signal, spectrum and removing it from the noisy signal spectrum to produce a "clean" signal spectrum,

usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the addition of vectors as taught by Zangi with the noise reduction of APA and Frey in order to provide a method of taking into consideration many different noise sources when reducing the noise levels in a signal.

In view of this Combination, Frey now suggests wherein each correction vector corresponds to a mixture component and each weight applied to a correction vector is based on the probability of the correction vector's mixture component given the alternative sensor vector (Figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. Each signal component could obviously be represented by a vector when being combined in the system of the combination above.).

The prior art of record, (Admitted prior art, Frey, Zangi, Park, and Griffin) does not teach or fairly suggest alone or in combination the limitations of claim 1, particularly the combination of limitations “forming an estimate of a noise-reduced value in file cepstral domain, converting the estimate of the noise-reduced value from the cepstral domain to a power spectrum domain, and then combining the estimate of the noise-reduced value in the power spectrum domain with an air conduction estimate” when combined with the other limitations in the claims. Therefore claim 1 is allowable.

7. Claims 2, 5, 6, 9, and 11 are allowed as they are dependent on and further limit allowable claim 1.

8. Consider claim 12, Park teaches a method of determining an estimate of a clean speech value (using figure 1), the method comprising:

receiving an alternative sensor signal from a sensor other than an air conduction microphone (output of accelerometer 34.);

receiving a noisy air conduction microphone signal from an air conduction microphone (output of microphone 31.);

identifying a which frequency of a group of candidate frequencies is a pitch frequency for a speech signal based on the alternative sensor signal (accelerometer 34 produces a signal which has primarily low-frequency speech components; column 3, line 21.); but does not teach specifically:

using the pitch frequency to decompose the noisy air conduction microphone signal into a harmonic component and a residual component by modeling the harmonic component as a sum of sinusoids that are harmonically related to the pitch; and

using the harmonic component and the residual component to estimate the clean speech value speech value by determining the weighted sum of the harmonic component and the residual component, the clean speech value representing a noise-reduced signal having reduced noise relative to the noisy air conduction microphone signal.

In the same field of noise reduction the APA teaches using the pitch to decompose the air conduction microphone signal into a harmonic component and a residual component and using the harmonic component and the residual component to estimate the clean speech value (One system or the prior art for estimating the noise in a speech signal uses the harmonics of human speech. The harmonics of human speech produce peaks in the frequency spectrum. By identifying nulls between these peaks, these systems identify the spectrum of the noise. This spectrum is then subtracted from the spectrum of the noisy speech signal to provide a clean speech signal; Specification, page 2, lines 3-10.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the harmonic separation scheme in conjunction with the signal cleaning method of Park, as the accelerometer would in fact provide a great estimation of the harmonics of the voiced speech.

The prior art of record, (Admitted prior art, Frey, Zangi, Park, and Griffin) does not teach or fairly suggest alone or in combination the limitations of claim 12, particularly the combination of limitations of " identifying which frequency of a group of frequencies is a pitch frequency for a speech signal based on an alternative sensor signal, determining an estimate of a clean speech value by determining a weighted sum of a harmonic component and a residual component where the clean speech value represents a noise reduced signal having a reduced noise relative to the noisy air conduction microphone signal" when combined with the other limitations in the claims. Therefore claim 12 is allowable.

9. Claim 13 is allowed as they are dependent on and further limit allowable claim 12.

10. Consider claim 14, Park teaches a computer-readable storage medium storing computer- executable instructions (figure 1, implemented on computer readable medium; column 8 line 25,) for performing steps comprising:

receiving an alternative sensor signal from an alternative sensor that is not an air conduction microphone (figure 1, output of accelerometer 34);

receiving a noisy test signal from an air conductive microphone (Figure 1 shows a microphone 31 that picks up both noise 22 and voice 31. The noisy test signal is then added 38 to the output of the adaptive filter 37 [fed by the accelerometer 34], the sum being used to adjust the adaptive filter 37; Abstract);

generating a noise estimate from the noisy test signal (Summing device 38 has a positive input terminal for receiving MICROPHONE INPUT SIGNAL, a negative input terminal for receiving the ENHANCED SPEECH SIGNAL, and an output terminal for providing a signal labeled "ESTIMATION ERROR" to the error input of adaptive filter 37; column 3, line 50. The estimation error is in fact a noise estimate.)

converting the noisy test signal (from 31) into at least one noisy test vector (output of microphone 31 fed to ADC 33, covering signal to a vector of digital samples.)

forming an alternative sensor vector from the alternative sensor signal (Park, ADC 36 converts the analog signal into a vector of time samples);

adding a correction vector to the alternative sensor vector to form an alternative sensor estimate of the clean speech value (Park, adaptive filter 37 filters the signal to produce a clean estimate. Filtering a signal is analogous to adding a corrective vector to it.)

but does not specifically teach:

subtracting a mean of the noise model from the noisy test vector to form a difference; and

setting a weighted sum of the difference and the alternative sensor estimate to form the estimate of the clean speech value estimate,

wherein the weighted sum is computed using the covariance of the noise model to compute weights for the weighted sum.

In the same field of noise reduction, Zangi teaches subtracting a mean of the noise model from the noisy test vector to form a difference (Figure 4, the AP 72 includes the one or more AP filters 74a-74M; paragraph 0090. Adaptive filters operate by estimating a noise spectrum, which will be an average or mean of the noise signal by the very nature of adaptive filters, from a noisy signal and removing it from the noisy signal to produce a “clean” signal, usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.);

The prior art of record, (Admitted prior art, Frey, Zangi, Park, and Griffin) does not teach or fairly suggest alone or in combination the limitations of claim 12, particularly the combination of limitations of “a weighted sum that is computed using the

covariance of a noise model to compute weights for the weighted sum" when combined with the other limitations in the claims. Therefore claim 14 is allowable.

11. Claims 15, 17, 18, 23, 24 and 29 are allowed as they are dependent on and further limit allowable claim 14

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DOUGLAS C. GODBOLD whose telephone number is (571)270-1451. The examiner can normally be reached on Monday-Thursday 7:00am-4:30pm Friday 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Edouard can be reached on (571) 272-7603. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

7/16/2008

/Talivaldis Ivars Smits/
Primary Examiner, Art Unit 2626

DCG